Fish & Wildlife Division

RESOURCE DATA AND SPECIES AT RISK SECTION

Status of the Western Blue Flag (*Iris missouriensis*) in Alberta:

Update 2005

Alberta Wildlife Status Report No. 21 (Update 2005)

Alberta Conservation Association

Alberta

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Status of the Western Blue Flag (*Iris missouriensis*) in Alberta:

Update 2005

Prepared for:
Alberta Sustainable Resource Development (SRD)
Alberta Conservation Association (ACA)

Update prepared by:
Kathryn Romanchuk

Much of the original work contained in the report was prepared by Joyce Gould in 1999.

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PREFACE

Every five years, the Fish and Wildlife Division of Alberta Sustainable Resource Development reviews the general status of wildlife species in Alberta. These overviews, which have been conducted in 1991 (*The Status of Alberta Wildlife*), 1996 (*The Status of Alberta Wildlife*) and 2000 (*The General Status of Alberta Wild Species 2000*), assign individual species "ranks" that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A key objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the general status exercise, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are *At Risk* or *May Be At Risk* in the province, that are of uncertain status (*Undetermined*), or that are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Alberta Conservation Association and the Fish and Wildlife Division of Alberta Sustainable Resource Development. They are intended to provide detailed and up-to-date information that will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information that will assist Alberta's Endangered Species Conservation Committee in identifying species that may be formally designated as *Endangered* or *Threatened* under Alberta's *Wildlife Act*. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

Western blue flag (*Iris missouriensis*), a plant species of western North America, is distributed primarily in the United States but just penetrates Canada along the eastern flanks of the Rocky Mountains in Alberta. It is considered rare in Canada and Alberta. Western blue flag is currently designated as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004) and ranked S2/G5 by the Alberta Natural Heritage Information Centre (ANHIC 2002a; J. Gould, pers. comm.). This report summarizes the existing information on western blue flag in Alberta to assist with the reassessment of its status in the province.

Western blue flag is a species that is generally associated with moist meadows and margins of streams, but in some cases it can be found in small depressions in relatively dry upland communities that experience early season moisture because of snowmelt or subsurface flow. It is mainly restricted to small portions of the Foothills Fescue and Foothills Parkland natural subregions—areas that have undergone extensive modification from their natural state by human activity. In 1999, western blue flag was known from six native occurrences; the population at one additional native site had been extirpated since its discovery in 1964 (Gould 1999b). Currently, there are 18 confirmed western blue flag sites (in 13 subpopulations) in Alberta. The increase in known number of sites has occurred because of increased inventories and participation in the western blue flag conservation program by the ranching community, which led to increased confidence in the reporting of known sites for this species.

In 1999, the population of western blue flag in Alberta was estimated at fewer than 7500 stems (Gould 1999b). In 2004, the Canadian portion of the western blue flag population is estimated at approximately 83 000 stems. It was previously believed that Alberta's western blue flag population was limited and declining; however, with a significant number of newly described sites and increased inventories and monitoring, stem counts have increased substantially.

Western blue flag was probably never abundant in Alberta given its specific habitat requirements and limited distribution. However, it is a significant part of our native flora and efforts to conserve the existing occurrences should continue.

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For the 2005 update prepared by Kathryn Romanchuk:
In addition to the above-mentioned people I would like to extend many thanks to Nyree Sharp (Alberta Conservation Association [ACA]), Robin Gutsell (AFWD), and Sue Peters (ACA) for sharing their knowledge and providing valuable editorial comments. Special thanks to Reg Ernst for completing all of the technical fieldwork associated with western blue flag inventories and monitoring since the year 2000, which has provided the most current information on western blue flag in Alberta, and an additional thank you for answering my countless questions during the preparation of this report; your patience and assistance was greatly appreciated. I would also like to gratefully acknowledge the following people for their contributions in the writing of this report: Joyce Gould (ANHIC) and John Rintoul (ANHIC) for sorting out element occurrence records, Richard Quinlan (AFWD) for providing information on western blue flag in Calgary and for his input into the report, Linda Cerney (ACA) for providing Western Blue Flag Conservation Program landowner information, and Cameron Lockerbie (Alberta Community Development—Parks and Protected Areas Division, Medicine Hat) for providing information on the management activities related to western blue flag within Police Outpost Provincial Park.

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INTRODUCTION

Western blue flag (*Iris missouriensis*) is the only species of iris native to Alberta. It is widely distributed in the western United States but appears in Canada only in Alberta where it is present along the southeastern flank of the Rocky Mountains. Western blue flag is mainly restricted to the Foothills Fescue and Foothills Parkland natural subregions, areas that have been extensively modified by agriculture with few native tracts remaining (Alberta Environmental Protection 1997a, 1997b). There are only a few native occurrences in the province, and the species is ranked S2/G5* by the Alberta Natural Heritage Information Centre (ANHIC 2002a). In September 2001, *I. missouriensis* was approved for designation as *Threatened* under Alberta's *Wildlife Act*. Western blue flag is also designated as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004) and is included under Schedule 1 of the federal *Species at Risk Act*.

In 1999, the Scientific Subcommittee (SSC) of Alberta's Endangered Species Conservation Committee (ESCC) recommended the status of *Threatened* for western blue flag. Their decision was based on the following population characteristics: small and declining population size, small distribution, and declining or fluctuating distribution. Data used in the status evaluation were obtained from an earlier status report completed in 1990 (Wallis and Bradley 1990), from a monitoring assessment done by Cornish (1998), and from the initial Alberta status report (Gould 1999b) that listed six natural occurrences of western blue flag in the province with a total population size of approximately 7500 stems. Our understanding of the population characteristics of western blue flag has changed since the SSC recommended it as *Threatened* in 1999. Inventories completed from 2000–2004 have given us reason to re-examine the original 1999 assumptions and status evaluation by the SSC (Ernst 2003, Romanchuk et al. 2004).

The purpose of this report is to summarize current and historical data and information on western blue flag in Alberta. This information can be used to reassess the status of the species and for prospective management and conservation strategies.

HABITAT

In Alberta, the western blue flag is primarily restricted to the Foothills Fescue and Foothills Parkland natural subregions (ANHIC 2002a). These subregions are characterized by a climate with mean annual precipitation ranging from 650 mm in the south to 500 mm in the north, with mean precipitation for May to September of 290 mm and a frost-free period averaging 90 days (Achuff 1994). The mean temperature for May to September is 11°C to 13°C for the Foothills Fescue and 12°C to 13°C for the Foothills Parkland (Achuff 1994). The soils of the Foothills Fescue are dark brown and black chernozems. Black chernozems are dominant in the grassland portion of the Foothills Parkland (Achuff 1994).

Ideal climates for growing irises have been described as having cold, dry winters with moist springs and early summers followed by warm, dry, mid- to late summers (Mathew 1989). Western blue flag is a plant of moist meadows such as those found along freshwater shorelines and streambanks. The species is often found in areas with soils that dry out later in the summer (Dykes 1913, Price 1966, Hitchcock et al. 1969, Mathew 1989, Cronquist 1994). It is intolerant of permanently wet conditions and heavy shading (Dykes 1913). Native occurrences of western blue flag in Alberta occur on sites that are on level terrain or gentle slopes with moisture conditions where water is removed slowly enough to keep the soil wet for most of (hygric) or a significant portion of (sub-hygric) the

* See Appendix 1 for definitions of selected status designations.

growing season (Wallis 1988, Cornish 1998). Many of the stands of western blue flag are in close proximity to willow thickets around depressions or drainages (Wallis and Bradley 1990). *I. missouriensis* can be found at elevations ranging from 10 m to 3000 m (Flora of North America Association 2004). Elevation for all of the known Alberta occurrences ranges from 914 m to approximately 2800 m (ANHIC 1998a).

In general, the habitat at monitored plots has been found to be variable, ranging from mesic sites along ephemeral drainages to moist depressions within willow, shrub or sedge communities, to relatively dry upland sites supporting rough fescue (*Festuca scabrella*) type communities. Detailed descriptions of the known western blue flag sites in Alberta can be found in the national maintenance and recovery plan (Canada Western Blue Flag Maintenance/ Recovery Team 2002) and Ernst (2002, 2003, in prep.).

The principal vegetation composition of Alberta western blue flag sites appears to be transitional between the shrubby cinquefoil/rough fescue (*Potentilla fruticosa/Festuca scabrella*) and the tufted hairgrass (*Deschampsia caespitosa*) habitat types described for northern Montana (Mueggler and Stewart 1980). Earlier surveys by Wallis (1989) indicated that Kentucky bluegrass (*Poa pratensis*) and inland bluegrass (*Poa interior*) dominated at most of the Alberta sites. Forbs that made up a significant component of the ground cover included Canada goldenrod (*Solidago canadensis*) and heart-leaved Alexander (*Zizia aptera*). Other associated species included silverweed (*Potentilla anserina*), smooth aster (*Aster laevis*), prairie gentian (*Gentiana affinis*), wild chive (*Allium schoenoprasum*), northern reed grass (*Calamagrostis inexpansa*), mountain cinquefoil (*Potentilla diversifolia*), graceful sedge (*Carex praegracilis*), timothy (*Phleum pratense*), alpine hedysarum (*Hedysarum alpinum*), northern bedstraw (*Galium boreale*) and wild strawberry (*Fragaria virginiana*).

Some additional information on species associations has been compiled for the updated status report. Currently, sedges (*Carex* spp.), Kentucky bluegrass and smooth brome (*Bromus inermis*) are the dominant species at the majority of the new western blue flag monitoring plots in Alberta. Other associated species include northern bedstraw, common yarrow (*Achillea millefolium*), wild strawberry, star-flowered Solomon's seal (*Smilacina stellata*) and heart-leaved Alexander. Another rare plant, blue camas (*Camassia quamash*), has been recorded at several of the new monitoring plots (at four separate sites) over the last few years (Ernst 2003, in prep.). Blue camas is ranked as an S2 species (6–20 occurrences) in Alberta (Vujnovic and Gould 2002).

The dominant native prairie flora at most of the Alberta western blue flag sites is characteristic of the Foothills Fescue Subregion: predominantly foothills rough fescue (*Festuca campestris*), Idaho fescue (*Festuca idahoensis*), Kentucky blue grass, western porcupine grass (*Stipa curtiseta*), June grass (*Koeleria macrantha*), Columbia needle grass (*Stipa columbiana*) and Parry oat grass (*Danthonia parryi*), as well as awned (*Agropyron unilaterale*) and northern (*Agropyron dasystachyum*) wheat grasses. Associated forb species commonly found include silvery lupine (*Lupinus argenteus*), common yarrow, fringed sage (*Artemisia frigida*), many-flowered aster (*Aster ericoides*), three-flowered avens (*Geum triflorum*) and northern bedstraw.

CONSERVATION BIOLOGY

There is very little information in the literature specific to the conservation biology of western blue flag. However, there is considerable information on the genus *Iris*, much of which is applicable to *I. missouriensis*.

Western blue flag is a member of the family Iridaceae (Mathew 1989). It is a perennial herb with thick (1 cm to 1.5 cm) rhizomes from which

are produced tufts of leaves. The flowering stalks bear two to four showy flowers (Moss 1983) that range in colour from pale blue to deep blue or lavender (Mathew 1989). White-flowered forms are also known but are rare (Price 1966). The flowers bloom sequentially rather than all at once (Eastman 1995). Flowering dates for western blue flag throughout its range are May through July (Hitchcock et al. 1969, Mathew 1989). In Alberta, flowering occurs between mid-June and early July (Wallis and Bradley 1990, Cornish 1998).

Both sexual and asexual methods of reproduction occur in western blue flag. Asexual, or vegetative, reproduction is accomplished through the branching and linear growth of the rhizome. Typically, irises are found in small patches of plants that are genetically identical (clones) and rarely form large pure stands (Eastman 1995). The periods of most active growth are autumn and early spring (Mathew 1989).

The large, showy flowers of irises are adapted for pollination by insects, primarily bees (Order Hymenoptera; Lyon 1973, Faegri and van der Pijl 1979, Schofield 1989, Eastman 1995) although flies (Order Diptera) have also been listed as pollinators (Faegri and van der Pijl 1979, Eastman 1995). Nectar "guides" are present on the sepals (falls) (Mathew 1989, Schofield 1989, Eastman 1995), which curve downward, thereby forming a landing surface. The petals (standards) are erect. The anthers and the stigmatic surfaces are positioned between the petals and sepals of the flower such that when an insect enters the flower in search of nectar, the insect deposits pollen already on its body onto the stigma and picks up more pollen from the anthers. The style and stigma are positioned so that they face away from the anthers, thereby reducing the chance of self-pollination (Eastman 1995).

The fruit of irises is a three-parted capsule that splits to release its globose, smooth-skinned seeds (Dykes 1913). The seeds can be dispersed by wind (Wallis and Bradley 1990) and can float on water, thus providing another means of dispersal (Eastman 1995). Fruiting stems persist for one year or more (Mathew 1989). Wallis and Bradley (1990) reported that the Alberta's population of western blue flag has good seed set.

Western blue flag is a beardless iris. Dykes (1913) reported that species of bearded and beardless irises are thought to flower within 18 months of seed germination. However, horticulturalists suggest that western blue flag produces flowers after three years and the seeds require a germination period of one to three months (Sunmark Seeds 1998). Propagation from seed can be obtained by cold wet stratification of the seeds (B. Greig, pers. comm.). Western blue flag grown at the Devonian Botanic Garden requires a germination period of two to three months, and flower production follows in two to three years (B. Greig, pers. comm.).

Eastman (1995) lists several insects, including thrips (Order Thysanoptera), that are known to reside in or forage on iris flowers. Faegri and van der Pijl (1979) also note that ants (Order Hymenoptera) occupy the flowers of many iris species and will feed on nectar and guard against beetles (Order Coleoptera) that lay eggs in the inflorescence. It is unknown which of these invertebrates, if any, use western blue flag in Alberta. Broad-tailed hummingbirds (*Selasphorus platycercus*) and various lepidopterans (butterflies and moths) have been documented feeding on nectar in *Iris missouriensis* in the Chiricahua Mountains in Arizona (Lyon 1973). Eastman (1995) also lists various butterflies as nectar-feeders on members of the genus *Iris*. The use of western blue flag by either hummingbirds or butterflies in Alberta is unknown.

The role of pollinators and outcrossing in seed production of *Iris missouriensis* is not known.

A recent study on *Iris versicolor*, a similar species from eastern North America, showed that at least one population was self-compatible and there was no evidence of inbreeding depression (Zink and Wheelwright 1997). This species is also insect-pollinated, exhibits clonal growth and occurs in isolated wet habitats (Zink and Wheelwright 1997). Self-pollination has been shown to occur in flowers that have not received pollen from other sources, by downward curvature of the stigmas, which brings them into contact with the anthers (Zink and Wheelwright 1997). In plants growing in exposed habitats, wind was a factor in increasing the chance of self-pollination through airborne movement of pollen by bringing neighbouring flowers into contact or by movement of the stigmas (Zink and Wheelwright 1997).

Investigation of the breeding system of a second eastern iris, *I. lacustris* (dwarf lake iris), by Planisek (1983) showed that this plant is self-compatible, with self-pollinated flowers having more fruits than outcrossed ones. In addition, fruit set is not correlated with the density of growing shoots or flowers. She also found that plants are at least seven years old before they flower. Her work demonstrated that ants dispersed the seeds of this species. The seeds of *I. lacustris*, however, have an eliosome (oil body), which is a known indicator of ant dispersal. The seeds of *I. missouriensis* are smooth and lack eliosomes (Dykes 1913) and it is not known whether ants or other agents aid in the dispersal of seeds of western blue flag.

The rhizome of the western blue flag is able to withstand heavy trampling and spread quickly upon removal of other vegetation (Dayton 1960). It is reported that plants can become weedy in certain instances (Montana State University Herbarium 1998). Eckert et al. (1973) found that conditions of poor range management promoted the growth of western blue flag in Nevada. They recommended control of the species by good range management, which included keeping range in good condition and mowing hay meadows. In Alberta, light or moderate grazing appears to be beneficial to western blue flag by reducing competition from other vegetation (Wallis 1989, Wallis and Bradley 1990, Cornish 1998). Heavy grazing is apparently detrimental to vegetative growth and flowering of the species both in Alberta (Wallis 1989, Wallis and Bradley 1990, Cornish 1998) and North Dakota (D. Lenz, pers. comm.), although, where habitat conditions appear to be optimal (e.g., the Basin sites in Alberta; see Appendix 2), western blue flag seems to do well under heavy grazing (Ernst 2003).

DISTRIBUTION

Western blue flag "sites," "occurrences," and "subpopulations": For the purposes of this report, it is important to define the terms "site," "occurrence," and "subpopulation." The number of individual "sites" has been determined based on the definition in the recovery plan of having a separation distance of greater than 100 m from other sites where the species occurs (Canada Western Blue Flag Maintenance/Recovery Team 2002). One exception is at Police Outpost Provincial Park (POPP), where the two sites of WBFL are not more than 100 m apart but they are being treated as separate because they are being managed differently. Separation distances were calculated by plotting GPS locations on 1:50 000 topographical maps and then measuring the distance between sites. In some cases a GPS unit was used in the field to determine the distance between sites (Ernst in prep.). At the time of this status report update, there are 18 known extant western blue flag sites in Alberta (Figure 1).

To distinguish distinct "occurrences," ANHIC follows NatureServe's guidelines, which use the minimum distance between populations across which gene flow is expected to be rare or non-existent. Accordingly, the criterion for recognizing distinct occurrences is having a minimum separation distance of 1 km

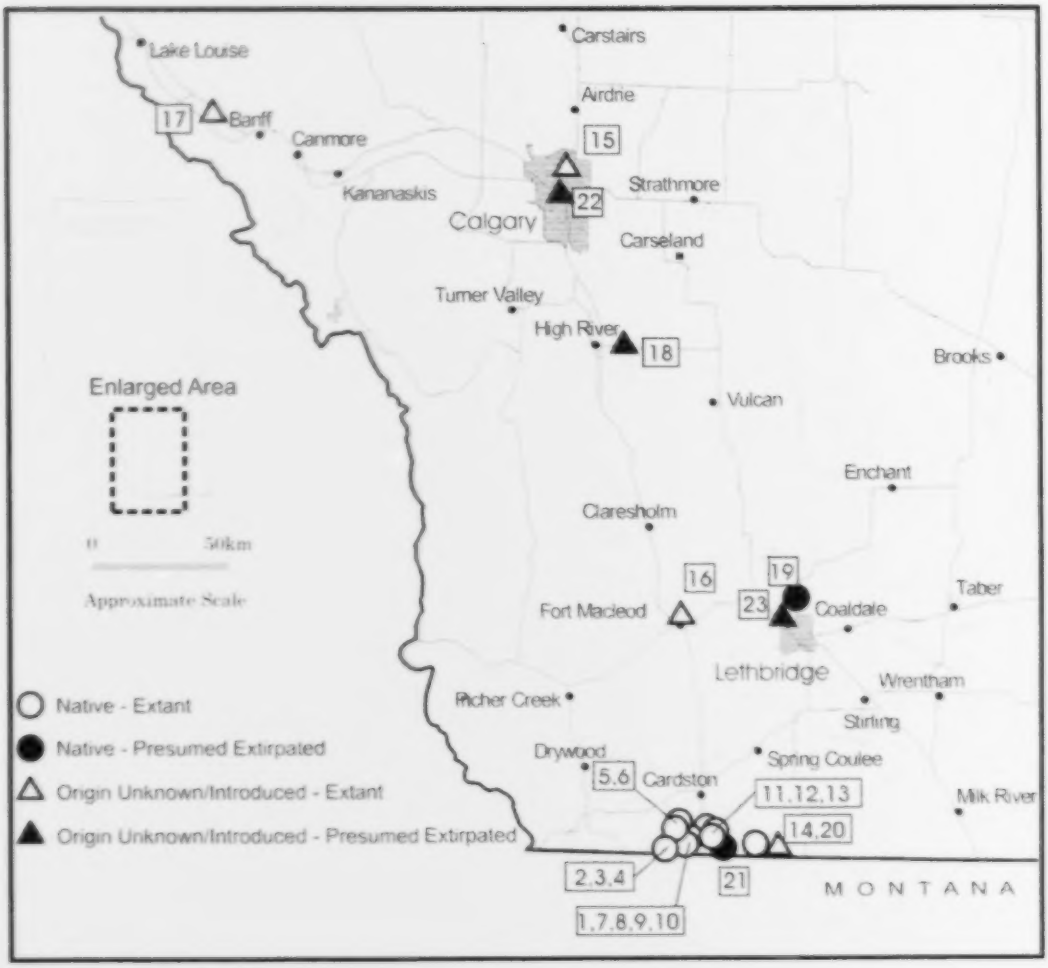

Figure 1. Known sites of western blue flag in Alberta.

(NatureServe 2004). ANHIC/NatureServe's definition of "occurrence" is consistent with the IUCN's (World Conservation Union) definition of a "subpopulation" (IUCN 2004). Based on this criterion, there are 13 distinct extant subpopulations of western blue flag in Alberta (and Canada); four of these subpopulations are of unknown origin (Table 1).

1. Alberta – Western blue flag was first discovered in Alberta in 1964 at two sites in the southwestern corner of the province (de Vries 1966). Gould (1999b) identified five additional native sites together with five sites where the species was thought to have been introduced. One of the apparent native occurrences that had been recorded in 1979 (Picture Butte) had since been extirpated. In summary, for the first draft of this status report there were 12 documented western blue flag sites: 7 native sites, one of which was classed as extirpated, and 5 sites presumed to be introduced.

Subsequent searches carried out from 2000 to 2004 confirmed five of the six original native western blue flag sites reported in Gould (1999b), and revealed an additional 12 sites. Nine of these newly discovered sites are located in a small corner near Carway south of Cardston, plus one site near Fort Macleod, one at the Calgary Airport, and another near Banff National Park (Romanchuk et al. 2004). Excluding three previously documented sites that apparently no longer exist (Picture Butte, Mary Lake, and Frank Lake [origin unknown]), at the time of this update report there are a total of 18 known western blue flag sites that exist in Alberta (Romanchuk et al. 2004; Figure 1).

Table 1. Known extant subpopulations[1] of western blue flag in Alberta.

Subpopulation (EO#[2], Site #[3])	Nearest Site	Separation Distance
Harrisville East (EO 06, Site 6)	Harrisville West	1300 m
Harrisville West (EO 06, Site 5)	POPP/Boundary	8.7 km
POPP East & West/Boundary (EO 04, Sites 2,3,4)	Carway Customs	4 km
Carway Customs (EO 20, Site 1)	Carway South	3350 m
Carway South (EO 08, Site 10)	Carway East/Carway North b	1400 m
Carway North b/Carway East (EO 08—considered part of Carway South, Sites 8,9)	Carway North a	1100 m
Carway North a (EO 02, Site 7)	Carway North b	1400 m
Basin South/Basin Central/Basin North (EO 22, Sites 11,12,13)	Carway North	5.2 km
Whiskey Gap (EO 01, Site 14)	Basin Central/Basin North	17.5 km
[4]NE of Whiskey Gap (EO 05, Site 20)	Whiskey Gap	4 km
[4]Banff National Park (EO 11, Site 17)	Calgary International Airport	>180 km
[4]Calgary International Airport (EO 10, Site 15)	Fort McLeod	~150 km
[4]Fort McLeod (no EO#, Site 16)	Harrisville East	~75 km

[1] Subpopulation is as defined earlier in text; some subpopulations comprise more than one site because of the separation distance criterion.
[2] EO# is the Element Occurrence reference number assigned by the Alberta Natural Heritage Information Centre. EO numbers are used by ANHIC to track the provincial population of species that may be at risk and to assess their rank. EO numbers are provided here to assist in cross-referencing information provided in this report with information in ANHIC's database.
[3] Site numbers correspond to the numbers in Figure 1.
[4] Subpopulations of unknown origin.

The majority of native western blue flag sites are restricted to the extreme southwestern edge of the province—the most floristically diverse portion of Alberta. This area has been described as a "botanical watershed" that runs east-west across the Rocky Mountains at approximately 50° latitude (Kuijt 1982). The flora south of this "divide" is more closely affiliated with that of the Rocky Mountains of northern Montana east of the continental divide rather than of the Rocky Mountains of Alberta to the north of it. Achuff (1997) points out the high diversity of the southwestern montane and foothills areas of the Rocky Mountains. For example, he documented 971 vascular plant species for Waterton Lakes National Park compared to 908 and 854 for Banff and Jasper national parks, respectively (Achuff 1997).

Most of Alberta's western blue flag sites occur at the extreme northern limit of the species' range in a narrow band in southwestern Alberta, approximately 30 km by 10 km, paralleling the international border, extending from the western portion of the Milk River Ridge to just west of Carway. The species has not been found on the Milk River Ridge itself despite the existence of suitable habitat there (Wallis 1989).

The distribution of the core Canadian population of naturally occurring western blue flag remains unchanged; it is still restricted to about 300 km^2 in southwestern Alberta, near Carway, which may be interpreted as the extent of occurrence. However, there are also three distinct subpopulations disjunct from the main Carway area for which the origins are unknown: one near Fort Macleod, another at the Calgary Airport, and one in Banff National Park near the Johnston Canyon area. The Banff occurrence is approximately 400 km away from the main native occurrences south of Cardston (Table 1). The Calgary Airport and Banff National Park occurrences had been previously described as introduced, but there is no evidence to support this assumption. At the Banff site a park warden's cabin had previously existed in the area of the western blue flag plants; however, it is felt that if this is an introduced occurrence it must date from a very long time ago owing to the large number of stems counted (7774; Appendix 2) and apparent advanced age of some of the blue flag clumps. The Banff Park interpreter also had no knowledge of the origin of this site (Ernst in prep.). The Fort MacLeod site is a newly described subpopulation that was first inventoried in spring 2004, consisting of one clump of western blue flag containing 101 stems (Appendix 2). The site is somewhat atypical because the clump is located on a dry upland area along the western edge of a chokecherry (*Prunus virginiana*) thicket. It is, however, on the Oldman River floodplain so it is possible that at one time the river channel may have been closer to where the western blue flag is located. Again, the origin of the subpopulation is unknown (Ernst in prep.).

There would need to be further investigations on the history of these sites, and possibly DNA analysis, to determine whether they are native or introduced, and to presume one or the other at this point would be speculative. An additional occurrence near the University of Calgary, categorized as introduced, was destroyed in 2003 as a result of topsoil stripping for construction (R. Quinlan, pers. comm.). Based on visual inspections, the area of occupancy of western blue flag plants in Alberta is estimated to be approximately 3 km^2 (R. Quinlan, pers. comm.).

Additional searches in spring 2004 failed to locate previously known and reported western blue flag stands at two other sites outside of the Carway area: Park Lake (origin unknown) just north of Lethbridge, and Frank Lake (presumed introduced), southeast of Calgary. It is speculated that these sites may have been extirpated by competition from non-native vegetation. An investigation into another occurrence south of Grande Prairie revealed that the iris reported there was the domestic variety. Also in spring 2004, a preliminary search for new western blue flag occurrences between

Cardston and Fort MacLeod was carried out. There appeared to be suitable habitat north of Cardston, but no plants were observed (Ernst in prep.).

The locations of western blue flag in Alberta represent the only known sites in Canada for this species. When the original 1999 status report was published, herbarium collections in Montana indicated that the nearest known western blue flag populations in Montana were approximately 6.5 km from the southernmost Alberta sites (C. Seibert and D. Dyer, pers. comm.). At that time it was recognized that these represented collections only, and other occurrences closer to the Alberta subpopulations may have existed from which collections had not been made. Recent results from research work on the DNA analysis of western blue flag completed in 2003 by a University of Alberta M.Sc. student revealed newly documented neighbouring populations in northern Montana, the closest one being approximately 4.5 km from the Boundary site in Alberta and within 1 km of the United States border (McPherson 2003).

2. Other Areas. - Western blue flag is a widespread species within the western United States. It is known from Oregon, Idaho, Montana, North Dakota, South Dakota, California, Washington, Colorado, Nevada, Arizona, New Mexico, Wyoming, Utah, Nebraska and northern Mexico (Figure 2). It has been reported in Minnesota (McGregor 1977), although no documentation exists for this record, and *Iris missouriensis* is not considered part of the native vascular flora of Minnesota (W. Smith, pers. comm.) or adjacent Wisconsin (J. Dobberpuhl, pers. comm.). Isolated populations were reported for British Columbia but these plants have since been reclassified as another species, *Iris setosa* Pallas ex Link (beachhead iris subspecies; G. Douglas, pers. comm.).

POPULATION SIZE AND TRENDS

1. Alberta. – The only population information available for the 1999 status review by the SSC was a population estimate (Wallis 1989) based on six known western blue flag occurrences at that time (Gould 1999b). Other information available at that time included a comparison of the number of flowering versus non-flowering stem counts and the difference in the numbers of stems counted in 1987 versus 1998 (3 sites, 6 monitoring plots) (Gould 1999b). With limited inventories having been completed at that time, an accurate estimate of the provincial population size was not available.

Since the 1999 status review by the SSC, a notable amount of additional information has been collected. Current inventory information shows that the overall population size and the number of sites and subpopulations are greater than previously believed, largely as a result of increased inventories and increased participation in the western blue flag conservation program and the reporting of additional sites. Back in 1999, six sites with naturally occurring western blue flag had been identified, representing a total Alberta population size of approximately 7500 stems (cluster of basal leaves) (Gould 1999b). As several stems can arise from an individual rhizome or rhizome segment, the number of individual plants is impossible to estimate without removing plants, but is undoubtedly lower than the total stem count (Wallis and Bradley 1990). Subsequent and more widespread searches and inventories carried out in 2000 and 2001 confirmed 11 naturally occurring western blue flag sites in Alberta with a population size estimated to be 14 757 stems (Ernst 2002). The stem count estimate following the 2002 inventory rose significantly to 69 200 stems (Ernst 2003). In 2003 the stem count estimate increased to 73 000 stems from 16 known sites. Currently, the Canadian portion of the western blue flag population is estimated at approximately 83 000 stems from 18 individual sites, representing 13 distinct subpopulations.

Figure 2. North American distribution of western blue flag (modified from McGregor et al. 1977 and Wallis and Bradley 1990).

These numbers should be interpreted with some caution, as they represent counts that were carried out in different years at different sites.

See Appendix 2 for a summary of all previous and current inventory data and Appendix 3 for recent monitoring plot data.

2002-2004 Surveys: A new inventory and monitoring protocol for western blue flag was designed and initiated in 2002 and repeated in 2003 and 2004 (Ernst 2003, in prep.). Although a monitoring protocol had been initiated in 1987 (Wallis 1988), it was decided that a new monitoring system had to be developed given the increased number and size of western blue flag sites. The annual monitoring program is based on sub-sample plots at large sites and complete censuses/inventories at smaller sites. Monitoring plots were established on particular sites to facilitate tracking the abundance and vigour of the western blue flag plants, and to monitor overall site trend over time. The number of monitoring plots set up at each site increased with site size and habitat variability. No monitoring plots were set up at the Whiskey Gap site because of the absence of suitable western blue flag clumps; instead, a full inventory (complete stem count) of the site is carried out each year. The POPP East and POPP West sites are being monitored using both methods (monitoring plots and a complete annual site inventory), largely because they are the only known native occurrences on public land and every effort is being made to maintain them in as healthy a condition as possible.

In 2002, data were collected from each of the monitoring plots established at 11 separate sites (Appendix 3). The primary data collected included the total number of stems in each plot and the number of fruiting/flowering stems. Changes in plant vigour and any other factors affecting western blue flag were also noted, including changes in associated species (Ernst 2003). This process was repeated in 2003 and 2004; the only differences were the addition of the Calgary International Airport monitoring plots in 2003 (Appendix 3), and the exclusion of the monitoring plots at the Basin Central site in 2004 because the landowner is no longer participating in the Western Blue Flag Conservation Program.

Results of 2002–2004 Monitoring: The monitoring protocol has been in place for only three years, thus any conclusions based on trends would be premature. Notable observations during this period include:

· A considerable increase in the amount of Kentucky bluegrass within the monitoring plots, although not quite as evident in 2004 compared to the previous year (Ernst 2003, in prep.).

· A substantial decrease in the number of reproductive stems and delayed flowering was recorded in 2004. At the majority of sites, flowering was delayed in 2004 compared to 2003. Dry conditions during the last two growing seasons may account for the delayed flowering and substantial reduction in the number of flowering stems (Ernst in prep.).

· Willow stands in the foothills showed substantial dead stems in the spring of 2004, many landowners suggested from drought (Ernst, pers. comm.).

Long-term monitoring may help track the relationship between moisture regimes and western blue flag vigour, but most information indicates that early season moisture is very important for maintaining healthy stands of western blue flag.

Population trends: Some western blue flag sites (Whiskey Gap, POPP West, Carway North a) have been monitored over several years, so it is now possible to identify some preliminary population trends for these sites. Apparent population declines for Police Outpost Provincial Park (POPP West) and Whiskey Gap were influential in the 1999 status decision by the SSC. While additional data from four consecutive years of monitoring indicates there is considerable fluctuation in stem numbers at

these sites, there is no longer an indication for an overall decline in population size. Similar fluctuations are displayed for other sites, although, for some, there are not as many years of information (Appendix 2 and Appendix 3). Based on the newly acquired data, there is enough current information on the Alberta western blue flag sites to suggest a stable population, taking into account natural fluctuations.

The number of historical occurrences of western blue flag is unknown. Wallis (1989) reported that the Police Outpost subpopulation may have been more extensive in the past and cultivation has reduced the amount of available habitat in which western blue flag occurs (Wallis et al. 1986). Subpopulations of western blue flag may in fact have been considerably higher in appropriate habitat in the past. However, much of the Foothills Fescue Grassland and Parkland has been brought into cultivation or otherwise modified (see "Limiting Factors" section, below).

2. Other Areas. – No accurate population estimates are available for western blue flag outside of Alberta. However, the species appears to be widespread and common within the core of its range in the western United States and has been considered a pest species in some areas (e.g., Nevada; Eckert et al. 1973).

LIMITING FACTORS

Wilcove et al. (1998) showed that habitat loss and degradation constituted the greatest threats to imperilled plants in the United States, with 81% of these plants being affected. Exotic species were listed as a threat to 57% of imperilled plants and overexploitation for 10%. Schemske et al. (1994) examined the main causes of endangerment for plant species listed under the United States *Endangered Species Act*. They found that development affected 20.4% of species, grazing 10.2%, collecting 10.2%, water control 8.2%, oil and gas extraction and mining 8.2% and trampling 8.2%. In a similar study, Flather et al. (1994) listed habitat loss as the most important factor in species endangerment, followed by competition from introduced species.

In addition to the above-mentioned threats, small populations face risks that fall into three categories: genetic (loss of genetic variation and hence ability to adapt), demographic (unpredictable changes in population sizes, composition, etc.) and environmental (Noss et al. 1997, Purdy 1998). Genetic and demographic threats increase with a decrease in the population size while environmental threats can be independent of population size (Noss et al. 1997).

Wallis (1988) identified modification of habitat, competition from introduced plants and heavy cattle grazing as threats to Alberta's population of western blue flag. He suggested that the main limiting factor in the habitat of native Alberta populations was a combination of moisture regime and grazing intensity. Cornish (1998) also identified grazing intensity and exotic species as threats and, in addition, considered flooding to be a cause of decline in one population. No additional limiting factors have been identified.

1. Habitat Loss, Alteration and Fragmentation. Western blue flag has probably never been common in Alberta given that it is at the northern edge of its range and that it has specific habitat requirements (see "Habitat" section, above). Its historical range is difficult to determine since information on its occurrence is not found in the literature prior to 1964. However, it is likely that alteration of habitat within its distribution has resulted in the loss of some pre-settlement populations.

Fescue-dominated systems, grassland and parkland, where western blue flag occurs, "are among the most threatened biogeographic regions on the Canadian plains because of

extensive cultivation" (Alberta Environmental Protection 1997a). It has been stated that 85% to 95% of the Parkland Natural Region has been lost through activities such as cultivation and urbanization and "any remaining areas should be considered endangered" (Alberta Environmental Protection 1997a). Some of the greatest losses of native prairie have been in the Foothills Fescue Grassland (Alberta Environmental Protection 1997b). Weins (1996) recently estimated that 95% of Fescue Grassland has been lost. Wallis (1989) estimated that less than 100 km^2 of the Foothills Grassland that might have harboured western blue flag in the past is in native condition. Wetlands in the grassland systems have also been under intense pressure from drainage and filling in. Estimates of loss of grassland in Alberta are 63% in the White Zone (settled portion of the province; Strong et al. 1993). Noss et al. (1997) argue that:

> "Habitat needs often must be considered in terms of the constellation of patches of potentially suitable, potentially connected habitat across a large landscape, rather than site by site. Single sites or a collection of disconnected sites will often be insufficient for long-term survival."

Effective management of a species therefore needs to include the conservation of potential habitat that is available for recolonization (Schemske et al. 1994).

2. Competition from Introduced Species. - Competition from non-native (introduced) species is an increasing threat to native flora and fauna (Wilcove et al. 1998). Indeed, the invasion of smooth brome is an ongoing concern at Police Outpost Provincial Park (Cornish 1998, Ernst 2002, 2003, in prep.). The primary vegetation noted in monitoring plots in 1987 was native grasses (i.e., Poa interior and Deschampsia caespitosa), though non-native species (i.e., Poa pratensis and Phleum pratense) were also recorded (Wallis 1988). Cornish (1996) reported that the site was dominated by smooth brome 11 years later. Flooding and the subsequent deposition of sediment at this site may have killed the native vegetation, allowing smooth brome to invade from nearby cultivated fields (Cornish 1998). Although different monitoring plots have been established at the POPP West site since then, heavy litter build-up and competing vegetation, particularly from smooth brome, have continually been documented as the primary concerns at that location (Ernst 2002, 2003, in prep.).

Competition from other introduced species, predominantly Kentucky bluegrass and to a lesser extent, timothy, has been recorded at sites other than Police Outpost Provincial Park and remains a potential threat (Ernst 2002, 2003, in prep.).

3. Heavy Grazing Pressure. - Eradication of western blue flag from native grasslands in Nevada was actively promoted in the 1970s (Eckert et al. 1973). This occurred because western blue flag is unpalatable to livestock (Pryor and Talbert 1958), may cause poisoning (Great Plains Flora Association 1986) and tends to increase in lightly to moderately grazed areas in parts of its range (Eckert et al. 1973). It is unknown whether native populations of western blue flag have been actively removed for similar reasons in Alberta.

Although grazing is considered an important factor in maintaining viable western blue flag stands, heavy grazing pressure appears to have a negative impact on western blue flag both in Alberta (Wallis 1989, Wallis and Bradley 1990, Cornish 1998) and North Dakota (D. Lenz, pers. comm.). Both Wallis (1988, 1989) and Cornish (1998) found that moderate to heavy grazing levels at the Whiskey Gap site resulted in a reduction in the number and vigour of plants. Although this is likely the case generally, this has not held true for the Basin North and Basin Central sites, where heavy grazing has occurred for some time, yet the two sites contain the largest numbers of western blue flag in Alberta.

This may be attributed to differences in season of grazing or other range management practices, or because the habitat conditions at both of the Basin sites appear to be very favourable to western blue flag. The Basin Central site receives heavy livestock use in late winter/early spring but is then rested until late summer, and the Basin North site is grazed in summer (Ernst 2003).

Levels of moderate to light grazing appear to be beneficial to *I. missouriensis* (Wallis 1989, Wallis and Bradley 1990, Cornish 1998, Ernst 2002). The main effect of grazing on western blue flag may not be due to grazing of the plant itself, but rather to alteration of drainage patterns and hydrology resulting from trampling. In 2002, Ernst (2003) reported an increase in the total number of stems as well as the number of fruiting/flowering stems at the Whiskey Gap site and attributed the increase, at least in part, to having excluded cattle from the site in spring 2002, in addition to unusually wet spring conditions.

Conversely, lack of grazing may also be a limiting factor. Police Outpost Provincial Park is not subject to grazing and as a result both western blue flag sites experience excessive litter build-up and the plants have to continually compete with smooth brome and other non-native grasses (Ernst 2002, 2003, in prep.).

4. Alteration of Hydrology. – In general, changes in hydrology constitute a limiting factor. Two natural conditions, drought and flood, may affect any of the western blue flag occurrences in Alberta. The POPP West site is near the shore of Police Outpost Lake, and the western blue flag there may be particularly at risk from being flooded out and being affected by periods of increased lake levels resulting in saturated soils during much of the growing season, which is not favourable to the growth of the species (Cornish 1998).

5. Horticultural and Medicinal Uses. – Western blue flag is also threatened by digging of rhizomes for horticultural and medicinal purposes. Western blue flag is an attractive plant and it is listed for sale in several gardening sources. Propagation can be done from either seed or rhizome although most gardening sources appear to be selling only seed. Western blue flag is included on the seed lists of some Alberta seed suppliers but it is difficult to track down the source of these seeds (i.e., whether collected from the wild or from nursery propagation: J. Lancaster, pers. comm.). The impact of the removal of seed on the long-term viability of populations is unknown.

Various medicinal uses of iris plants (including western blue flag) have been reported. These include induction of vomiting, cleansing the system and treating *Staphylococcus* sores (Moore 1979, Kershaw et al. 1998). In the paper "*Plants and the Blackfoot*" (Johnston 1987) there is no mention of western blue flag use by the Blackfoot. Members of a Blackfoot tribe in southern Alberta advised they had no knowledge of any historical use of western blue flag by their ancestors (R. Ernst, pers. comm.). The rhizomes of western blue flag may also have anticancer properties (Wong et al. 1987). The full extent of collection of western blue flag in Alberta for horticultural or medicinal purposes is currently unknown.

6. Climate Change. – No data are available specifically on the impact of climate change on western blue flag. However, Morse et al. (1993) estimated that 7% to 11% of North America's vascular plant species would be negatively affected by a 3°C increase in temperature. Purdy (1998) indicates that species such as western blue flag, which are at the northern edge of their range, may be better able to respond to global climate change because of their adaptation to local photoperiod, climate and soils. Therefore, what appears to be marginal habitat at present may become favourable habitat in the future (Purdy 1998).

7. Pests and Diseases. – No plant diseases or pests have been reported from any of the known populations of western blue flag in Alberta. However, Barry Greig (pers. comm.) of the University of Alberta indicates that the species is susceptible to fungus and other diseases when grown in cultivation at the Devonian Botanic Garden.

8. Herbicides. – Herbicides, including 2,4-D and glyphosate (commonly known as Roundup) have been used in various parts of the United States for weed control. The use of 2,4-D in areas in close proximity to western blue flag was found to be 91% to 100% effective in suppressing the plants, whereas glyphosate was 100% effective (Eckert et al. 1973). The use of herbicides at the Alberta sites is unknown; however, the use of agricultural herbicides as a range management tool is a potential threat to western blue flag.

9. Pollinators and Seed Dispersal Agents. – Pollination requires a minimum density of individuals and this may be a particularly important factor in small populations of western blue flag (Allee et al. 1949, Powell and Powell 1987). The role of pollinators and seed dispersers in determining the status of western blue flag is unknown in Alberta. No information is available on whether bees are the active pollinating agents in irises or if some other agent (e.g., other invertebrates, wind) is involved. Given that western blue flag is largely restricted to isolated patches in southern Alberta, and that flowering density may be quite low, the role of pollinators may be small but important. It may be that self-pollination is important in some of these populations. Detailed demographic and genetic studies of Alberta western blue flag populations are required to ascertain this.

STATUS DESIGNATIONS*

STATUS HISTORY

Western blue flag has long been recognized as a rare plant in Alberta (Argus and White 1978, Packer and Bradley 1984, ANHIC 1996, ANHIC 1998b, Gould 1999a). Argus and White (1978) defined a rare species as one that "has a small population within the province or territory [and] may be restricted to a small geographical area or it may occur sparsely over a wide area." Packer and Bradley (1984) used the same definition but refined it to include only those species known from five or fewer sites. Wallis et al. (1987) suggested the designation of *Endangered* for western blue flag. In a summary of the information on the rare vascular plants of Alberta, Wallis (1987) suggested five categories for priority of conservation. Category 1 has the highest priority. *Iris missouriensis* was classified as a Category II species meaning "one that is rare in much of, or a significant part of, its North American range, or is generally rare or uncommon in North America" (Wallis et al. 1987).

The Alberta Natural Heritage Information Centre was established in 1994 and the first tracking list for vascular plants ranked western blue flag as S1S2 (between 5 and 6 occurrences; ANHIC 1996). This designation was based on the current botanical knowledge for this species in the province. Collation of specimen information and subsequent mapping of occurrences suggested the more appropriate rank of S1 (five or fewer occurrences and few remaining individuals).

The species was also recognized as "rare" in British Columbia in 1985 (Straley et al. 1985). However, the populations native to British Columbia have been re-examined and it has been determined that they are actually a different species, *Iris setosa* (G. Douglas, pers. comm.).

Western blue flag is listed in *Rare Vascular Plants in Canada* (Argus and Pryer 1990). The national rank these authors assigned was N2 with a Canadian priority of 1 (Argus and Pryer 1990). A rank of N2 means that an element has 6 to 20 occurrences in Canada. A ranking of 1 indicates the highest priority for conservation.

* See Appendix 1 for definitions of selected status designations.

CURRENT STATUS

1. Alberta. – In September 2001, Alberta's Minister of Sustainable Resource Development approved western blue flag to be listed as a *Threatened* species under Alberta's *Wildlife Act*. In April 2005, the Alberta Natural Heritage Information Centre changed the rank of western blue flag to S2 provincially (6 to 20 occurrences and restricted range) (J. Gould pers. comm.).

2. Other Areas. – Because of its restricted range and low number of occurrences, western blue flag has been designated as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada since 1990. In 2000, COSEWIC reviewed the status of western blue flag in Canada and upheld its classification as *Threatened*. This status denotes a species that is "likely to become endangered if limiting factors are not reversed" (COSEWIC 2004). Western blue flag is listed as *Threatened* under Schedule 1 of the federal *Species at Risk Act* (Government of Canada 2004). The Global Conservation Status Rank assigned to this species is G5, meaning that it is considered secure within its global range. Western blue flag is listed as having a National Conservation Status Rank of N5? in the United States; it has been given a subnational conservation rank of S1 in Nebraska and S2 in North Dakota but it is not considered to be rare in any of the other states in which it occurs, and in many is considered abundant. In Canada, the National Conservation Status Rank for western blue flag is N1, signifying "often 5 or fewer occurrences" (NatureServe 2004).

RECENT MANAGEMENT IN ALBERTA

In 1989 a management plan for western blue flag was prepared (Wallis 1989). However, at that time no government agency had responsibility for protection and management of plants and few of the suggestions and recommendations were implemented. Many significant changes have taken place since then.

In 1999, to afford its protection, western blue flag was recommended by the ESCC for listing as a *Threatened* species under Alberta's *Wildlife Act*. In September 2001, Alberta's Minister of Sustainable Resource Development approved the *Threatened* listing. Accordingly, recovery planning for western blue flag was initiated. A 12-member multi-stakeholder group comprising landowners, conservation groups and resource managers formed the provincial recovery team, and a maintenance and recovery plan for western blue flag was developed in late 2001/early 2002. Major objectives of the plan included the development of an ongoing inventory and monitoring program for western blue flag and providing updated information on western blue flag numbers based on current data. In April 2002, Alberta's Minister of Sustainable Resource Development approved the *Maintenance and Recovery Plan for Western Blue Flag (*Iris missouriensis*) in Canada* as the provincial recovery plan for the species.

Listing Process: Western blue flag was the first plant to receive approval to be listed as a *Threatened* species in Alberta. Following the listing's Ministerial approval, it was necessary to develop appropriate Alberta regulations to support the *Threatened* designation; Alberta regulations must be developed and approved before western blue flag is officially included in the *Wildlife Act*. In January 2002, recommendations for Alberta regulations pertaining to western blue flag were sent from the recovery team to the Director of Wildlife for approval. However, the process was delayed because of uncertainties surrounding the new federal *Species at Risk Act* at that time. Since then, a decision was made to revise the regulations for western blue flag so that they are applicable to all plant species currently approved for listing. This whole process, being new for everyone involved, has delayed western blue flag being formally legislated as a *Threatened* species under Alberta's *Wildlife Act*. The revised regulations continue to be developed.

1. Monitoring. – Wallis (1989) recommended that triennial monitoring and annual inspections of the known populations be done. Cornish (1998) did the only detailed monitoring study subsequent to Wallis' initial work. The monitoring and evaluation protocol outlined in the maintenance and recovery plan recommended that western blue flag sites be monitored at five-year intervals, and more frequently where downward trends were noted (Canada Western Blue Flag Maintenance/Recovery Team 2002). This guideline has been exceeded. Inventory and monitoring of western blue flag has been completed more frequently than originally planned because of the continued discovery of additional blue flag sites. Inventory and monitoring surveys have been conducted in 2002–2004, and these activities are expected to continue in 2005.

Western Blue Flag Conservation Program: The Western Blue Flag Conservation Program was established to deliver the monitoring and stewardship activities identified in the Action Plan component of the recovery plan (Canada Western Blue Flag Maintenance/Recovery Team 2002). The program, which is administered by the Alberta Conservation Association, is a voluntary and cooperative conservation initiative that encourages range/habitat management to ensure the long-term maintenance of the naturally occurring populations of western blue flag in Canada in a sustainable ranching environment. The program contracts the services of an independent range consultant to do a full range inventory of all property held by the participant and to consult with the land steward on ways to improve ranch management. The consultant then produces an ecologically based range management plan that includes recommendations for ranch improvements to benefit western blue flag and maintain or improve rangeland condition. Subsequently, through partner funding, participants in the program are eligible to receive assistance to complete the recommended range improvements to allow them to effectively manage their land in a manner that also sustains western blue flag (Romanchuk et al. 2004).

To gain the required landowner support, landowner consultations regarding the Western Blue Flag Conservation Program were initiated in spring 2001. By late 2001, several landowners agreed to participate in the program. In 2002, a total of five ranchers and one land manager with western blue flag on their property had taken advantage of the program. Two new landowners joined the program in 2003 for a total of eight participants to date. Currently one landowner is reconsidering his involvement because of recommendations for ranch improvements not meeting his expectations. Range management plans have been completed for all eight properties; however, the implementation of management recommendations has not yet taken place for one of the newest participants (Romanchuk et al. 2004). Communications continue with two additional landowners to join the program; however, neither of them has chosen to participate to date (L. Cerney, pers. comm.).

Program evaluation: In 2003, Rangeland Conservation Service (RCS) Ltd. was contracted by the Alberta Conservation Association and Alberta Sustainable Resource Development to review the Western Blue Flag Conservation Program and develop a template for monitoring and evaluating the program. The resulting report, titled *Program Evaluation and Monitoring Plan for the Western Blue Flag Conservation Program* (Rangeland Conservation Service Ltd. 2003), reviews the inventory and monitoring protocol for western blue flag and introduces a monitoring process to evaluate the success of range management plans and improvements in achieving the desired objectives of conservation of the species and native prairie in general.

As part of the program evaluation, a landowner questionnaire was developed for the participants in the Western Blue Flag Conservation Program

(Romanchuk et al. 2004). It was designed to gather information on previous and current land uses, grazing systems and stocking rates to help provide an evaluation of the newly implemented management recommendations and their overall effectiveness toward the objectives of maintaining western blue flag and maintaining or improving range condition. Program participants were also questioned on their willingness to sign voluntary or legal agreements recognizing their participation in the Western Blue Flag Conservation Program.

Two participants (ranchers) have been completing grazing record forms at the end of each grazing season to keep track of stock rotations and stocking rates. Over time, this information could provide valuable data regarding the correlation between certain management practices and trends in range condition and western blue flag numbers.

2. Research. – Various research activities, such as detailed evaluation of western blue flag ecology, were recommended in the recovery plan, but were not initiated in 2002–2003. However, a University of Alberta M.Sc. graduate student completed some research on the genetic diversity of western blue flag populations in southern Alberta and neighbouring sites in northern Montana through DNA analysis (McPherson 2003). The research indicates that there has been some historic or current gene flow amongst these populations.

Alberta Community Development's Parks and Protected Areas branch is considering options for small-scale grazing to benefit western blue flag and the grassland community in Police Outpost Provincial Park. The benefits and practicalities of using sheep to graze areas of introduced exotic grasses will be evaluated. The possibility of haying some of the areas, except those around the western blue flag, is also being considered (C. Lockerbie, pers. comm.).

3. Communication. – Several actions and strategies to educate the public and provide information about the management and conservation of western blue flag and other rare plants have been undertaken. Information on western blue flag was included in the *Alberta's Threatened Wildlife* brochure series (Alberta Forestry, Lands and Wildlife 1991b) and rare plant fact sheets (Alberta Forestry, Lands and Wildlife, no date) produced by the Alberta government. Western blue flag is the emblem of the Alberta Native Plant Council, a not-for-profit group whose objectives are to "promote knowledge of Alberta's native plants, conserve Alberta's native plant species and their habitats and preserve this diverse resource for the enjoyment of present and future generations."

In April 2002 the *Maintenance and Recovery Plan for Western Blue Flag (*Iris missouriensis*) in Canada* was printed as Report No.1 in a new Recovery Plan Report Series. Copies of the plan were distributed to members of the public through Alberta's Fish and Wildlife offices and the Remington Carriage Centre in Cardston, and by members of the recovery team. To inform the public about the recovery plan, enhance awareness and gain landowner confidence, a public open house was held in Cardston in May 2002. A poster display describing the Western Blue Flag Conservation Program was produced and was set up at the open house, at two conferences, and during Wildlife Week in Lethbridge. In summer 2002 the maintenance and recovery plan was posted on the Alberta Species at Risk website at: http://www3.gov.ab.ca/srd/fw/riskspecies/.

The interpretive program at Police Outpost Provincial Park (POPP) was to be amended to include information on western blue flag. Unfortunately, this did not occur because all interpretive services in the park were cancelled. Preliminary discussions have taken place regarding a volunteer role in delivering this action item. A species at risk sign that describes

western blue flag has been erected at the park, and the most recent information brochure on POPP includes a photograph of the flower. In conjunction with the Waterton Wildflower Festival, on June 23, 2004, a recovery team member conducted an outdoor interpretive tour of the western blue flag sites at the park.

Presentations on the Western Blue Flag Conservation Program were given at the Prairie Conservation Endangered Species Conference and the Alberta Environmentally Sustainable Agriculture conference in late February and early March 2004, respectively. Also in March 2004, the western blue flag recovery team leader delivered a presentation in Manyberries to the recovery team for soapweed (*Yucca glauca*), the yucca moth (*Tegeticula yuccasella*) and western spiderwort (*Tradescantia occidentalis*) on the blue flag process for public involvement in decision making.

The storage of information on the distribution and habitat of western blue flag is carried out by ANHIC, and technical reports produced for Alberta Sustainable Resource Development, Fish and Wildlife Division are housed in ANHIC's library.

SYNTHESIS

The only known occurrences of western blue flag in Canada are located in Alberta. The species is predominantly restricted to a small area (about 300 km^2) in southwestern Alberta near Carway, but also occurs at three more remote sites disjunct from the core subpopulations: in Calgary, Fort Macleod and Banff National Park. The origin of these three occurrences is unknown. The number of known sites has increased from 6 in 1999 to a total of 13 subpopulations (comprising 18 individual sites) in 2004 because of increased inventories and participation in the western blue flag conservation program by the ranching community, which led to increased confidence in the reporting of sites for this species. This, of course, does not demonstrate species recovery, but rather the fruits of greater search effort and increased confidence of the community. It is, however, important additional information that was not available to the SSC in 1999. Our estimate of the total number of stems and the total population size has risen because of greater search effort and improved reporting of sites. The total Alberta western blue flag population has risen substantially from 7500 stems in 1999 to approximately 83 000 stems in 2004. The newly acquired data suggests a stable population, with natural fluctuations being taken into consideration.

Even if the current *Threatened* status is not upheld in light of the updated information, continuing to conserve western blue flag habitat through the voluntary cooperation of landowners should remain paramount in order to maintain this species, and the species' status should be reviewed periodically to ensure that conservation measures are working.

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Appendix 1. Definitions of selected legal and protective designations.

A. **The General Status of Alberta Wild Species 2000** (after Alberta Sustainable Resource Development 2001)

2000 Rank	**1996 Rank**	**Definitions**
At Risk	Red	Any species known to be *At Risk* after formal detailed status assessment and designation as *Endangered* or *Threatened* in Alberta.
May Be At Risk	Blue	Any species that may be at risk of extinction or extirpation, and is therefore a candidate for detailed risk assessment.
Sensitive	Yellow	Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.
Secure	Green	Any species that is not *At Risk, May Be At Risk* or *Sensitive*.
Undetermined	Status Undetermined	Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.
Not Assessed	n/a	Any species known or believed to be present but which has not yet been evaluated.
Exotic/Alien	n/a	Any species that has been introduced as a result of human activities.
Extirpated/Extinct	n/a	Any species no longer thought to be present in Alberta (*Extirpated*) or no longer believed to be present anywhere in the world (*Extinct*).
Accidental/Vagrant	n/a	Any species occurring infrequently and unpredictably in Alberta, i.e., outside its usual range.

B. Alberta Wildlife Act/Regulation

Species designated as *Endangered* under Alberta's *Wildlife Act* include those listed as *Endangered* or *Threatened* in the Wildlife Regulation.

Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if limiting factors are not reversed.

C. **Committee on the Status of Endangered Wildlife in Canada** (after COSEWIC 2003)

Extinct	A species that no longer exists.
Extirpated	A species that no longer exists in the wild in Canada, but occurs elsewhere.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if limiting factors are not reversed.
Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk	A species that has been evaluated and found to be not at risk.
Data Deficient	A species for which there is insufficient scientific information to support status designation.

Appendix 1 continued.

D. Heritage Status Ranks: Global (G), National (N), Sub-National (S) (after Alberta Natural Heritage Information Centre 2002b, NatureServe 2004)

G1/N1/S1	5 or fewer occurrences or only a few remaining individuals. May be especially vulnerable to extirpation because of some factor of its biology.
G2/N2/S2	6 to 20 or fewer occurrences or with many individuals in fewer locations. May be especially vulnerable to extirpation because of some factor of its biology.
G3/N3/S3	21 to 100 occurrences, may be rare and local throughout its range, or in a restricted range (may be abundant in some locations). May be susceptible to extirpation because of large-scale disturbances.
G4/N4/S4	Typically > 100 occurrences. Apparently secure.
G5/N5/S5	Typically > 100 occurrences. Demonstrably secure.
GX/NX/SX	Believed to be extinct or extirpated, historical records only.
GH/NH/SH	Historically known, may be relocated in the future.
GNR/NNR/SNR	Unranked—conservation status not yet assessed.

E. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range.
Threatened	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Appendix 2. Inventory information for all known western blue flag sites in Alberta, 1989-2004, including sites that are presumed to be recently extirpated. (Site numbers correspond to numbers in Figure 1).

Site	Date	Total # Stems	# of Fruits/Flowers
1. Carway Customs (EO 20)	11/07/02	264	3
2. POPP East (EO 04)	27/06/00	175	14
	04/07/01	177	26
	27/06/02	198	15
	17/06/03	277	29
	18/06/04	262	15
3. POPP West (EO 04)	1989	650	6
	1998	325	1
	27/06/00	219	14
	04/07/01	203	8
	27/06/02	458	70
	17/06/03	384	27
	18/06/04	398	35
4. Boundary[1] **(EO 04)** (contains 3 sites)	02/07/01	4996	547
5. Harrisville West (EO 06)	11/07/02	956	n/a
6. Harrisville East (EO 06)	1989	1500	n/a
	03/07/00	2091	304
	30/06/02	n/a	n/a
7. Carway North a (EO 02)	1989	5000	n/a
	05/07/00	6049	256
	16/07/02	n/a	n/a
8. Carway North b (EO 08)	15/07/02	1033	134
9. Carway East (EO 08)	15/07/02	800	134
10. Carway South (EO 08)	06/07/00	570	42
	05/07/02	916	41
11. Basin South[2] **(EO 22)**	09/07/02	>10 000	n/a
12. Basin Central (EO 22)	09/07/02	11 149	2390
13. Basin North (EO 22)	10/07/02	29 487	4473
14. Whiskey Gap (EO 01)	1989	203	0
	1998	111	2
	27/06/00	171	2
	27/06/02	233	10
	20/06/03	201	2
	14/06/04	153	0

Appendix 2 continued:

15. Calgary Airport[4] (EO 10)	08/07/03	3774	55
16. Fort MacLeod[4] (no EO#)	08/06/04	101	3
17. Banff Nat'l Park[4] (EO 11)	02/07/04	7774	771
18. Frank Lake[3] (EO 12)	1995	unknown	unknown
	2004	0 (presumed extirpated)	n/a
19. Picture Butte (EO 03)	1979	Present (# unknown)	unknown
	1989[5]	0 (presumed extirpated)	n/a
20. Northeast of Whiskey Gap[4] (EO 05)	1992	Present (# unknown)	unknown
	1999	200-250	unknown
21. Mary Lake (EO 07)	1989	small	unknown
	2000	0 (presumed extirpated)	n/a
22. University of Calgary[3] (EO 09)	2003	0 (presumed extirpated)	0
23. Park Lake[4] (no EO#)	1993	small	unknown
	1998	20	3
	2000	0 (presumed extirpated)	n/a

[1] Site inventoried in 2001; however, no monitoring plots were set up in 2002—landowner not participating in western blue flag conservation program, but has a conservation easement
[2] Site not formally inventoried; based on ocular estimate
[3] Considered introduced (see Gould 1999b)
[4] Sites of unknown origin
[5] Indicated as eliminated in Wallis 1989

Appendix 3. Comparisons of western blue flag monitoring plot data, 2002-2004.

Site	# of Plots	Total # Stems			Total # Fruits/Flowers		
		2002	2003	2004	2002	2003	2004
Carway Customs	2	253	219	234	3	8	9
POPP East	2	76	87	84	13	10	9
POPP West	2	85	81	64	16	6	4
Harrisville West	1	513	658	636	78	104	34
Harrisville East	8	356	367	432	46	40	48
Carway North a	10	425	417	425	67	20	14
Carway North b	3	274	264	245	21	11	9
Carway East	3	144	154	143	20	15	8
Carway South	4	96	83	95	7	6	3
Basin Central	11	1268	1719	n/a	144	202	n/a
Basin North	15	856	1013	982	104	152	80
Calgary Airport	4	n/a	359	n/a	n/a	6	n/a

*n/a – information not available (no previous data, or data not collected)

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